(No Model.)

L. H. NASH.

EXPLOSIVE VAPOR ENGINE.

No. 331,079. Patented Nov. 24, 1885.

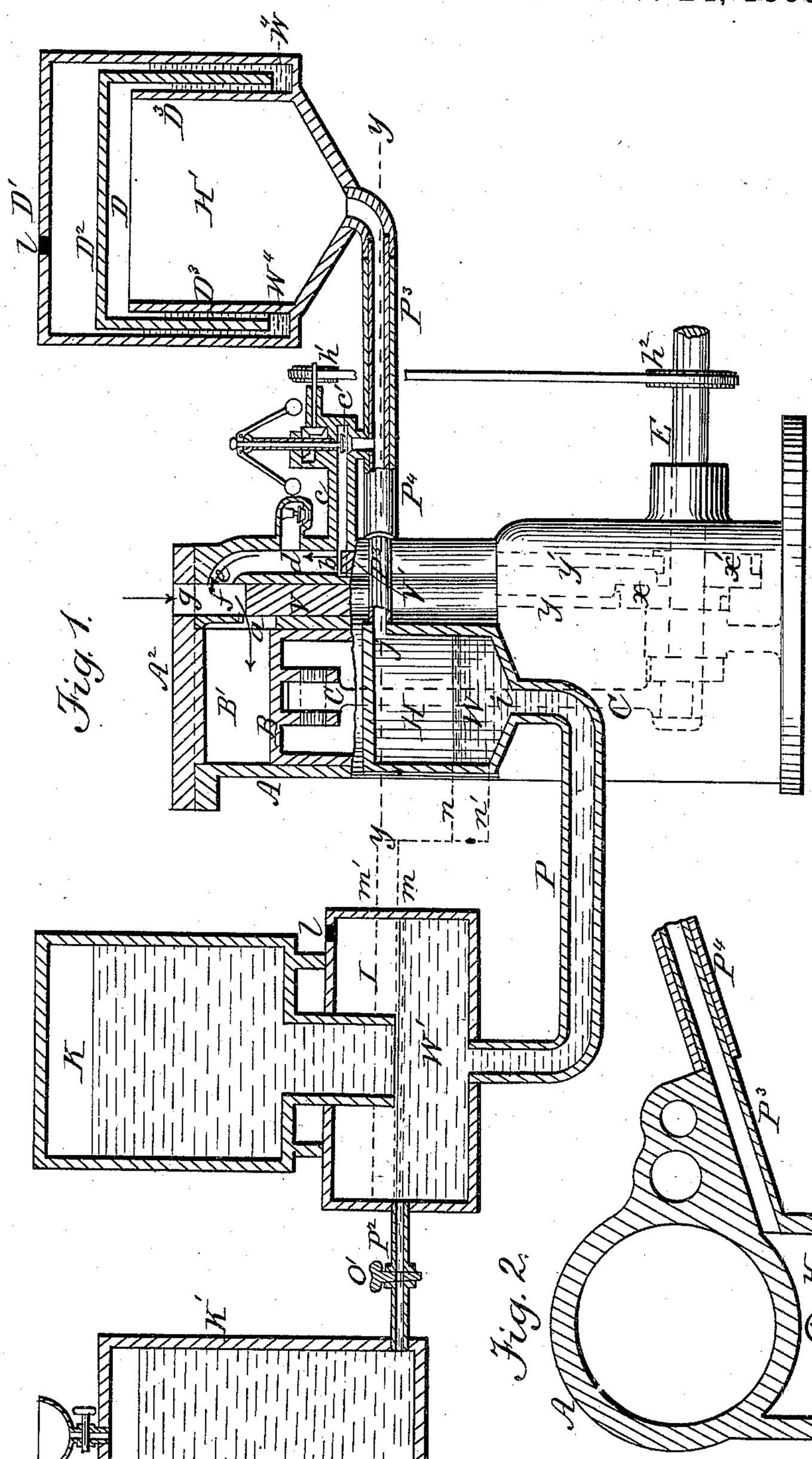

Fig. 1.

Fig. 2.

Witnesses:
W. E. Chapin
W. F. Evans

Inventor:
Lewis Hallock Nash
by Johnson & Johnson
Attys.

UNITED STATES PATENT OFFICE.

LEWIS HALLOCK NASH, OF BROOKLYN, ASSIGNOR TO THE NATIONAL METER COMPANY, OF NEW YORK, N. Y.

EXPLOSIVE-VAPOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 331,079, dated November 24, 1885.

Application filed October 23, 1884. Serial No. 146,264. (No model.)

To all whom it may concern:

Be it known that I, LEWIS HALLOCK NASH, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented new and useful Improvements in Explosive-Vapor Engines, of which the following is a specification.

In patents granted to me for improvements in gas-engines, dated December 4, 1883, I have described a gas-engine adapted to vaporize a liquid fuel injected into the hot cylinder to produce the required charge for operating the engine, in connection with a storage-chamber for the working-fluid so produced, and means for conducting it into the power-cylinder. I have also described in said patents the vaporization of liquid fuel introduced or injected into a heated portion or chamber of the engine-casing to form the working-fluid and conducting it from said chamber into the working-cylinder by the operation of the valves, whereby the engine is adapted to generate and supply the working-fluid in sufficient quantities to form with the air a combustible charge for operating the engine as an explosive-gas engine. My present improvements are directed to the production of an explosive-vapor engine having the same objects and effecting the same purpose by the vaporization of volatile oil supplied to a chamber heated by the waste heat of the engine.

The object of my improvements is to operate an engine by vapor produced from a volatile oil supplied at intervals in charges to the power-cylinder, instead of using the gas from the street-mains as the working-fluid, whereby explosive-vapor engines may be used in places where there is no provision for supplying gas from street-mains, or for use in ships' launches, or otherwise where it may not be desirable to use illuminating-gas as the working-fluid; but as the vapor produced from volatile oils will condense rapidly and carry with it more or less liquid particles into the engine, where they must instantly be evaporated by contact with the hot valves and cylinder, and thereby render the charge variable, the operation of the engine would thereby be rendered unsteady, and thereby objectionable. My invention avoids this objection by delivering the working-vapor direct from a boiler or producer into the cylinder in a dry and superheated condition. For this purpose the supply-pipes must not only be arranged so as to drain back into the vapor-producer, but must enter the engine at a hot part, and the supply-pipes must be so protected as to attain a heat from the engine sufficient to evaporate the liquid particles as fast as they may condense on the walls of the supply-pipes, and thus prevent liquid particles from being carried into the engine.

My invention embraces, in combination with an engine operated by successive charges of the vapor of a volatile liquid and air sufficient to support its combustion in the cylinder, a boiler for containing the oil and producing the vapor by the waste heat of the engine, a pressure-chamber for receiving and storing the vapor for supplying the engine, arranged independent of the latter, means for supplying or injecting the liquid fuel into the boiler, the pipes which connect the engine with the storage-chamber and the boiler being arranged to drain into the latter and deliver a dry vapor to the engine from a chamber having a capacity to respond to the demands of the engine by automatic pressure. The supply-reservoir is connected with the bottom of the boiler, so that the liquid may be forced out of it by the excessive pressure of the vapor therein, and thereby lessen the quantity of the liquid evaporated, and regulate the quantity of the vapor formed and the pressure of the same within the boiler. The engine so combined with an oil-vaporizer effects the exclusion of the liquid particles, with which the vapor is necessarily to some extent laden, from the combustion-chamber of the engine, and the latter is supplied with vapor from a pressure-storage chamber in direct communication with the boiler and draining directly therein. The objects stated I attain in the manner which I will now proceed to describe, reference being had to the accompanying drawings, in which—

Figure 1 represents in vertical sectional elevation an explosive-vapor engine having a vapor-generating chamber or boiler heated by the engine in communication with

a liquid-fuel-supply reservoir, and a pressure-storage chamber adapted to contain a variable volume of vapor in communication with said engine generating-chamber and the engine-valves; and Fig. 2, a horizontal section on the line *y y* of Fig. 1, showing the vapor-generating chamber or boiler of the engine and a portion of the pipe which communicates with the pressure-storage chamber of variable volume independent of the engine.

I have shown in connection with the evaporator or boiler a simple form of explosive engine provided with a simple form of governor for controlling the supply of vapor to the engine-valves, using a charge of air at atmospheric pressure; but my invention may be applied to any gas-engine—as, for instance, to the engine shown and described in the application for a patent filed by me May 8, 1884, under Serial No. 130,786, which is a single-acting gas-engine.

In the drawings which illustrate such engine, A represents the cylinder; B, the piston, and C the rod connecting the piston with the crank-shaft E. The main valve V is operated by the eccentric *x* and rod *y*, so as to control the inlet of the air and vapor into the cylinder and the discharge of the waste products therefrom. A vapor-supply valve, V′, is similarly connected and operated by the rod *y′* and eccentric *x′*, the two valves being placed side by side, and operating in chambers which communicate with the air, with vapor-supply pipe, and with the combustion-chamber of the cylinder. The chamber of the valve V opens at the top of the cylinder-head A^2 at *g*, and into the combustion-chamber B′ by the side port, *a*, which is opened and closed by said valve. The vapor-supply valve V′ is of less length than the valve V, and its chamber extends up and opens at *e* into the chamber *f* of the valve V, and forms the vapor-supply passage *d*, isolated from the direct communication with the cylinder-chamber. The valve V′ operates a port, *b*, at the bottom of the vapor-supply passage *d*, which port communicates with an outside vapor-supply pipe, *c*, upon which the governor is arranged for operating the valve *c′*, which controls the vapor-supply. The governor is operated by the pulleys *h′* h^2 from the crank-shaft E and connecting-gear. In this construction the air required to complete the combustible charge is sucked into the cylinder by the action of the engine through the passage *f*, which opens at the top cylinder-head.

The fuel-boiler or evaporating-chamber H may be formed within any suitable part of the casing or frame of the engine where it will receive a sufficient heat to evaporate the oil to form the working-vapor, the heat for this purpose being derived through the walls of the engine from the waste heat of the combustion of the working-fuel. As shown, this fuel-boiler H is upon the outside wall of the power-cylinder, as cast therewith, having the inlet-opening *i*, for the liquid fuel, at the bottom, and the outlet-opening *j*, for the vapor, at the top, which communicates with the bottom of a pressure-storage chamber, D, having a variable volume. The boiler or evaporating-chamber is supplied with a liquid fuel through the pipe P, which connects the bottom of said boiler with the bottom of a reservoir, I, having an air-vent, *l*, and which may be placed at any desired distance from the engine, and at a height sufficient to cause the liquid to freely flow therefrom by gravity into the boiler, but not to fill the latter.

The volume of the liquid in the boiler is regulated by the pressure of the vapor generated therein, and in proportion to the degree of such pressure the liquid, W, therein will be forced back into the supply-reservoir, so that the level of the liquid, W′, in the latter will at all times during the operation of the engine be higher than the level of the liquid in the boiler. If the level of the liquid in the reservoir be represented by the line *m* and that in the boiler by the line *n*, the height *m n* will indicate the degree of the pressure of the vapor in the boiler.

To keep the reservoir I constantly supplied with the liquid fuel, it is supplemented by an air-tight reservoir, K, having a pipe extending into the reservoir I, so as to act, upon the principle of the well-known student's lamp, to maintain the supply in the reservoir, having direct communication with the boiler. I may, however, place this supplemental reservoir K any desired distance from the reservoir I, and construct it of any desired capacity, as shown at K′, and connect it with the reservoir I by a pipe, P^2, provided with a cock, O′, so that the level of the liquid in the reservoir I will be governed by said pipe.

The pressure-storage chamber D is constructed so as to be capable of expanding and contracting, according to the pressure of the vapor therein, to give out by its contracting pressure a sudden and free volume of the vapor into the cylinder the instant the engine-valves open. The chamber for this purpose may be of any suitable construction that will adapt itself to a variable volume of pressure. It may be formed by a flexible bag, such as that used with the gas engine and the street-main gas-supply pipe for the same purpose. The chamber shown in the drawings consists of a metal box, D′, having a hopper-bottom, and an inner circular partition, D^3, of less height than the box D′, whereby to form a mercury-chamber, W^4, into which an inverted hollow float or cup, D^2, dips and forms a cover for the vapor-chamber. The space above the inverted cup D^2 communicates with the outer air by the opening *l*, and the space under said cup forms the storage-chamber H′ and connects with the boiler by the pipe P^3, so that the condensation of the vapor will drain back into the boiler. This chamber may be placed any desired distance from the engine; but the vapor-conducting pipes should be covered by a non-conductor, P^4, to prevent as far as pos-

sible the condensation of the vapor in the pipes. The pipe *c*, which carries the governor-valve *c'*, should be arranged so as to drain into the pipe which connects with the storage-chamber, and the latter is connected so as to drain into the boiler. The boiler may, however, receive the drainage from the condensation direct from the vapor-supplying pipe P^3, and also from the storage-chamber separately, because to effect the desired result it is not necessary that the storage-chamber should be placed in the vapor-supply pipe, or that the vapor should flow through it to the engine; but it must have free communication with the boiler, or with the pipe leading therefrom.

In the arrangement of the pressure-storage chamber which I have shown the vapor will enter the storage-chamber through the pipe P^3, passing the governor-valve *c'*, and when the engine-valves are open the float will fall quickly and force the vapor back in the required volume through the same pipe and through the governor-valve *c'* into the engine. The closing of the engine-valves causes the chamber to again fill and expand according to the quantity and pressure of the vapor generated in the boiler.

When the engine is not in use, the oil will stand at the same level in the boiler and in the supply-reservoir. When the engine is working, the vapor will fill the chamber of the boiler above the liquid and pass into and fill the expansible pressure-chamber, and in proportion to the pressure of the vapor generated the liquid will be increased or diminished in quantity in the boiler, and thus regulate the amount of surface of the liquid which is in contact with the hot walls of the boiler, and thus regulate the quantity of the fuel evaporated. This regulating action is illustrated in the drawings by the lines *m n*, and if *m* be the level of the liquid in the supply-reservoir and *n* that of the liquid in the boiler, the latter will be under a pressure measured by the difference of level *m n*. An increase of the vapor-pressure may cause the levels to change to *m' n'*, which will then represent the pressure of the vapor in the boiler. Should the pressure increase sufficient to force all the liquid from the boiler into the supply-reservoir, then the evaporation of the liquid will practically stop until the pressure decreases sufficiently to allow the oil to again feed by gravity into the boiler. By this means the pressure in the boiler can never be greater than that of the hydraulic head, and the quantity of fuel evaporated will be controlled by the quantity of the fuel in the boiler.

By making the supply-reservoir of large surface in comparison with the volume of the boiler the variations in the level of the liquid in the supply-reservoir will not be very great, and hence the pressure of the vapor in the boiler will be constant enough to render the pressure or discharging function of the storage-chamber always active.

I have shown no means for igniting the charge, as I may use any of the known methods by which such ignition may be effected.

I have shown an engine operating with a charge at atmospheric pressure, but my invention may be applied to any engine operating to compress its charge.

Any suitable means for heating the engine-casing preliminary to the operation of the engine may be employed. A convenient way, when illuminating-gas can be obtained, is to supply and operate the engine with such gas until it is sufficiently heated to produce its own combustible vapor, as stated. If no such supply can be obtained, the engine can be started by means of a fuel-vapor generated by an independent boiler or evaporator heated by any suitable means; but I make no claim herein to such means, as said means are described and claimed in my pending application, filed September 22, 1885, under Serial No. 177,849; or heat may be applied directly to the engine-casing to heat the whole casing to the temperature required to operate the engine when its continued operation is effected by supplying its own fuel in the way described.

I claim—

1. The combination, with the engine, of a boiler for containing a volatile oil formed upon and heated by the waste heat of the engine, and a pressure-storage chamber for the working-vapor produced within said boiler, having free communication with the boiler and engine-valves, substantially as described, for the purpose specified.

2. The combination, with the engine, of a boiler formed upon and heated by the waste heat thereof, a pressure-storage chamber for the working-vapor produced within said boiler, and a reservoir for supplying said boiler with volatile oil, the reservoir and the boiler being connected, so that the pressure of the vapor in the latter will regulate the quantity of the oil therein, and thereby regulate the quantity of oil evaporated.

3. The combination, with the cylinder of an explosive engine, of the boiler H, cast on the side thereof and heated by its waste heat, having the inlet-opening *i*, for the supply of oil at the bottom, and the outlet-opening *j*, for the vapor at the top, a pressure-storage chamber, and pipes connecting the latter with the engine-valves, substantially as described, for the purpose specified.

4. The combination, with the cylinder of an explosive engine, of the boiler H, cast on the side thereof and heated by its waste heat, a pressure-storage chamber connecting therewith and with the engine-valves, and a supply-reservoir arranged to automatically supply said boiler with a limited quantity of oil, substantially as described, for the purpose specified.

5. The combination, with the cylinder of an explosive engine, of a boiler cast on the side thereof and heated by its waste heat, a pressure-storage chamber connecting with said

boiler and with the engine-valves, and a supply-reservoir having communication with the bottom of said boiler, whereby the pressure of the vapor in the boiler will act to regulate the quantity of the oil exposed to its evaporating-surfaces, substantially as herein set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LEWIS HALLOCK NASH.

Witnesses:

H. W. BRINCKERHOFF,

W. C. WESTERVELT.